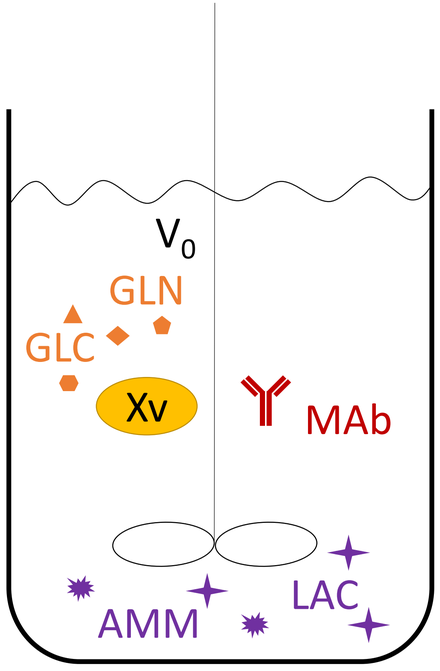
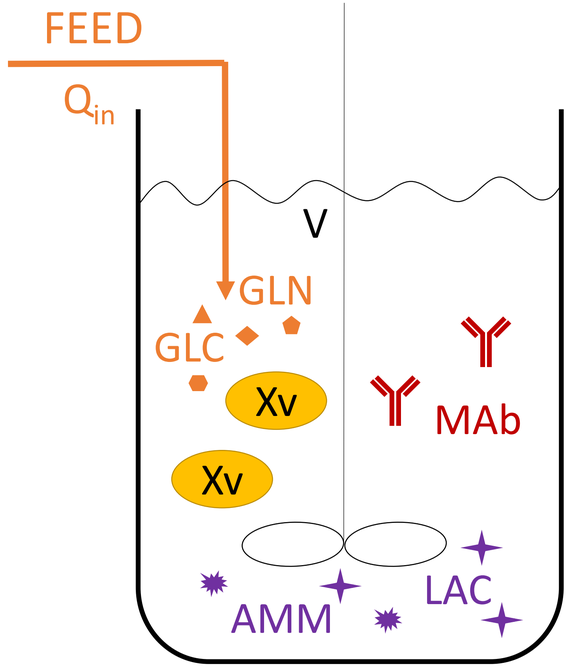
Batch



$t_{end} < 6$ d

$dV/dT = 0$

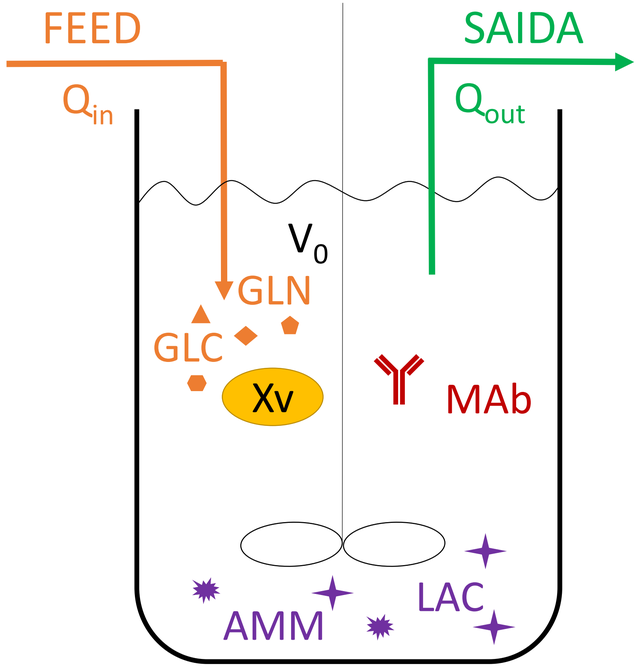
Fed-Batch



$t_{end} < 15$ d

$dV/dT = Q_{in}$

Continuous

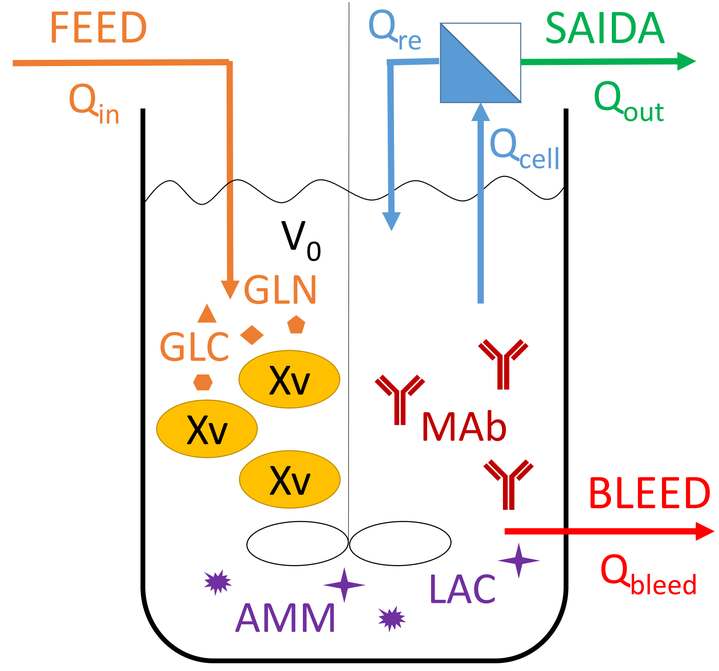


$t_{end} < 180$ d

$dV/dT = Q_{in} - Q_{out} = 0$

$D < (\mu - \mu_d) \approx 0.5\ d^{-1}$

Perfusion



$t_{end} < 180$ d

$dV/dT = Q_{in} - Q_{out} - Q_{bleed} = 0$

$(1-\alpha)\cdot D < (\mu - \mu_d)$

$Q_{bleed} = 0$ $\quad X_v < X_{v,max}$

$Q_{bleed} = (\mu - \mu_d)V$ $\quad X_v > X_{v,max}$